

Sept. 28, 1937.

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2,094,013

EXPULSION FUSE CUT-OUT

Original Filed Feb. 25, 1930 2 Sheets-Sheet 1

Fig. 1.

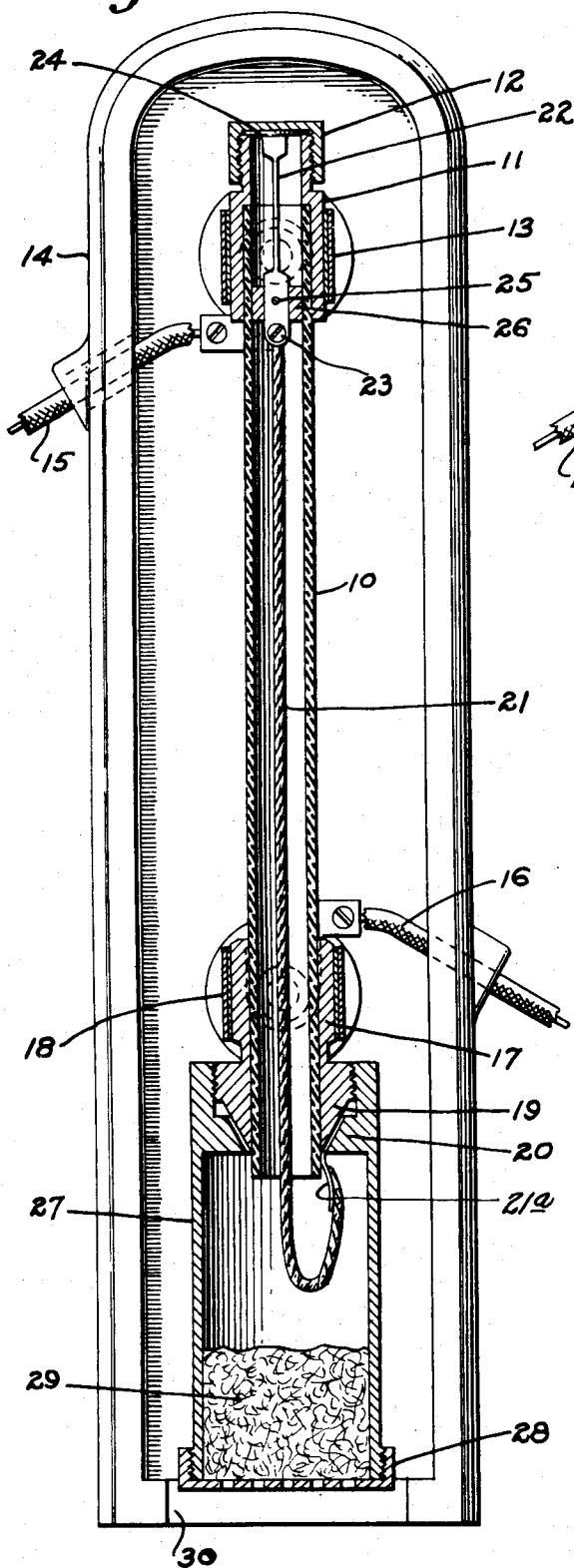
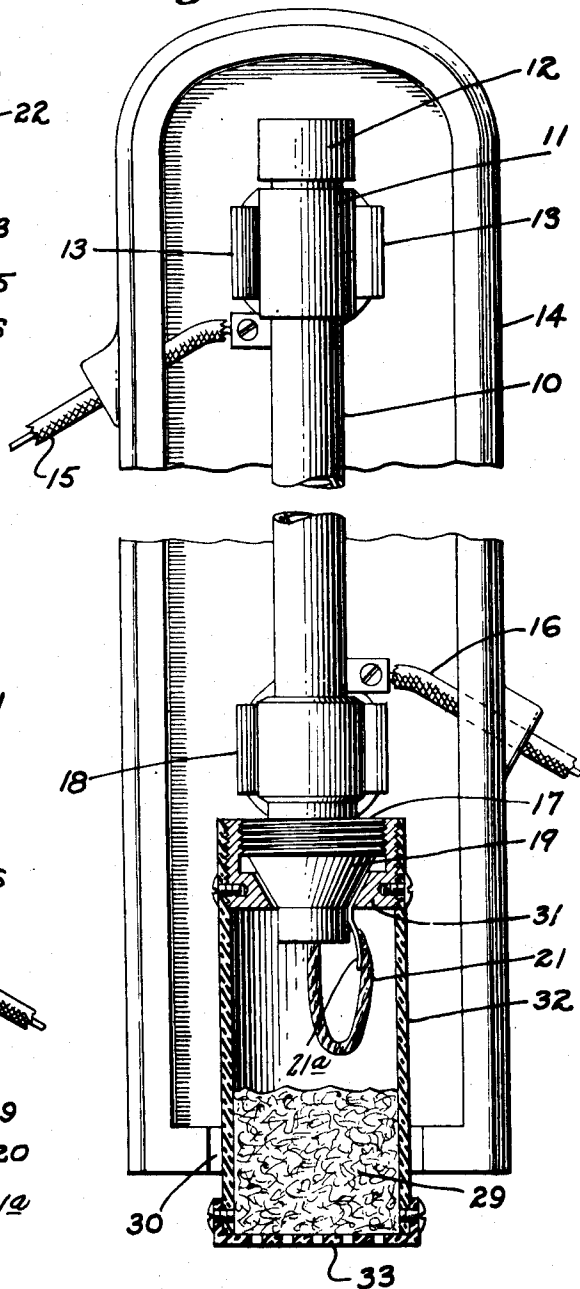


Fig. 2.



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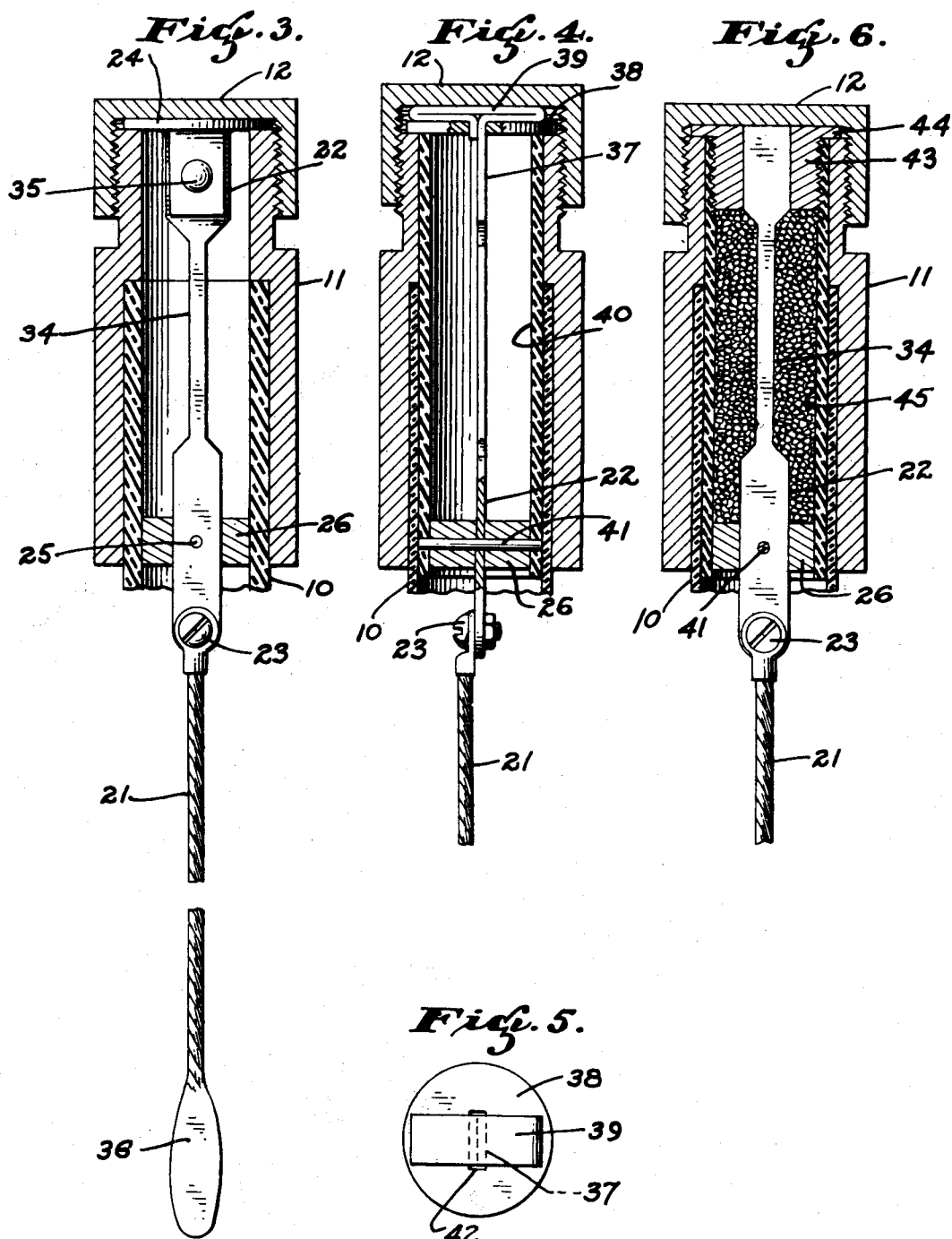
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EXPULSION FUSE CUT-OUT

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EXPULSION FUSE CUT-OUT

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Renewed February 25, 1935

25 Claims. (Cl. 200—127)

My present invention relates to a new and improved electric circuit cut-out of the expulsion type and particularly to a cut-out of the so-called high tension type such as are used in connection with the high voltage transmission systems; the present application being a continuation in part of my co-pending application entitled "High tension fuse", filed July 9, 1928, Serial No. 291,214.

An object of my invention is to provide a new and improved electric cut-out of the fusible type which, by reason of its construction, is adapted to interrupt high voltage circuits with a minimum of fusion of metal.

A further object of my invention is to provide in an expulsion fuse a compound fuse link within a fuse enclosing housing, consisting of a fusible element of relatively short length and relatively low melting point material connected in series with a relatively high conductivity flexible conductor, the parts of which can be projected to a considerable distance and thus provide for a drawing out of the arc to a length sufficient to interrupt the circuit.

A further object of my invention is to prevent the parts of the fusible element and the means by which it is connected to the electric circuit from being projected out into the surrounding space adjacent to the cut-out.

Other objects and advantages of my invention will be in part pointed out and in part evident from the following description, taken in connection with the accompanying drawings, wherein I have shown by way of illustration and not of limitation preferred embodiments of my invention.

In the drawings—

Fig. 1 is a front elevation, partially in section, showing one embodiment of my improved fuse located in an insulating cut-out housing,

Fig. 2 is a view similar to Fig. 1, with parts broken away, showing a modified form of my improved cut-out, and

Figs. 3, 4, 5, and 6 are enlarged detailed views showing various modified forms of fusible elements and methods of assembly.

The typical fuse links or fuse elements of cut-outs of the expulsion type now furnished by various manufacturers are made of a strip of fusible material or of a twisted wire, along which there is a small or restricted section at one end which is disposed adjacent the closed end of a cylindrical chamber or fuse link holder. The cut-outs which are provided for small currents generally have fuse links of lead, tin, or suitable alloy of low conductivity and low melting point. These mate-

rials, if used for fuse links in cut-outs of large current carrying capacity, must necessarily have a large cross section of metal and, as a result, when a short circuit occurs, if the circuit is to be properly protected, there must be provided a large amount of metal to be volatilized or melted. When such a large amount of metal is fused in any enclosed cut-out fuse holder, the gases generated create a high pressure within the holder and this in a great many cases explodes the holder and often fractures the surrounding box to such an extent that a complete new box and fuse holder must be provided; and, further, when the fuse link holder or expulsion tube explodes or fractures, the arc and gases are allowed to escape, thus creating a path of low resistance between the terminals. The resultant arc generally maintains itself under these conditions, especially where the voltage of the circuit is of a high order, and the cut-out is destroyed.

To remedy these defects, many manufacturers have resorted to metals of higher conductivity, such as aluminum and zinc, in order that they might reduce the cross section of the fusible portion of the fuse links. The materials having this smaller cross section have relatively high melting points and when the current is maintained at or near the melting point for any length of time, the heating up of the fuse link, due to its resistance, in a great many cases chars the insulating fuse link holder and eventually destroys the same; and where the holder is not, in fact, totally destroyed, the expulsion tube or fuse link holder generally explodes when a short circuit occurs, due to its weakened condition and the cut-out is of no value as a circuit interrupting device.

It would appear that these latter defects might be remedied by providing a fuse link of larger cross section than the current would warrant so that the fuse link would be worked well below its melting point and thus avoid undue heating. However, when a circuit is protected in this manner, the fuse link requires such a long time interval before it melts that when an overloading or short-circuit occurs, the fuse will not rupture and open the line before the main oil switch has opened and, as a result, the main circuit is interrupted before the cut-out clears the branch circuit.

Another disadvantage of the prior art cut-outs is due to the fact that the large amount of fusible metal contained therein, because of its slow action in fusing, tends to draw the arc out to a considerable length, which results in the throwing of

molten metal and flaming gases several feet from the cut-out housing. This latter feature is exceedingly dangerous to humans; also the excessive molten metal expelled will ignite any dry materials adjacent or near the cut-out or may explode any vapors if the cut-out is near a service station or oil reservoir. These disadvantages have been very definitely established by various tests and experiments upon various cut-outs manufactured up to the present time.

In order to overcome the above disadvantages, I propose to provide an expulsion chamber or fuse link enclosing housing having one of its ends reinforced and closed so that a relatively short fusible element may be disposed in this closed end and for the remaining length of the fuse enclosing housing I provide a relatively non-fusible conductor of flexible material having high conductivity, such as copper, which will be projected out of the fuse enclosing housing by the generation of gas within the enclosing housing when the fusible element ruptures.

In the several figures of the drawings, wherein like numerals refer to like parts, 10 designates a suitable insulating cylindrical expulsion tube or fuse link holder. The upper end of the tube 10 is enclosed and reinforced by a cylindrical member 11, upon which there is screwed a suitable cap 12. The cylindrical member 11 is adapted to form one terminal of the fuse cut-out and, as such, it engages a suitable receptacle or terminal clip 13 located in the upper end of an insulating housing 14 through the sides of which suitable line conductors 15 and 16 project and connect with a suitable external power circuit. At the lower end of the expulsion tube 10 there is provided a second cylindrical member 17 which forms the other terminal of the cut-out and which co-operates with a second clip or contact 18, from which the conductor 16 extends. The cylindrical member 17 is provided with a conical portion 19 which co-operates with a screw-threaded container 20 to form a clamping means for the lower end of a flexible conductor 21, which extends upwardly through the expulsion tube 10 and connects with the lower end of a fusible element 22 disposed in the upper end of the expulsion tube 10. The conductor 21 is shown as connected with the fusible element by means of a screw 23. It should be understood here, however, that the conductor 21 might be connected to the fuse by other means, as by soldering or welding. The upper end of the fusible element 22 is provided with a cylindrical cap 24 which engages the end of the cylindrical member 11 and is clamped into electrical contact therewith by means of the cap 12.

Secured to the fuse 22 by means of a pin 25 or other means, there is provided a cylindrical plug 26 which is freely slidable within the expulsion tube 10 so that it may be projected therefrom in the event of the generation of gas within the enclosed end of the tubular member 10, i. e., in the chamber surrounding the fuse 22. With this arrangement, it will be seen that when the fuse 22 is ruptured, there will be generated a considerable amount of heat and gases, due to a vaporization of the metal of the fuse, which will be in the nature of an explosion. This will project the cylindrical plug 26 outwardly in much the same fashion as would be a bullet out of a gun barrel and, as a result, the flexible conductor 21 will also be projected out of the housing 10 so that the length of any arc which exists will be increased at a rapid rate and the arc thus extinguished.

In order to prevent the conductor 21 and any

molten fused material being projected out into an exposed position where it would be dangerous to an attendant, I provide that the cylindrical member 20 at the bottom of the fuse holder 10 be extended outwardly so as to form a relatively large expansion chamber for gases and the conductor 21. This expansion chamber consists of a cylindrical portion 27, the bottom end of which is enclosed by a perforated cap 28. As an additional precaution I may also provide within the cylindrical portion 27 a sufficient amount of metallic wool or other material 29 which will act to rapidly chill any hot gases and molten metal which are projected from the expulsion tube 10.

It is understood the metal wool may or may not be used, as desired. The extra flexible conductor 21 will also act as an arc extinguisher and substitute for the wool as its piles up on the perforations of the cap 28 or 33 at the bottom of the chambers of 27 and 32 when the rupture of the fuse element 22 forces the plug 26 and the flexible conductor 21 out of the tubular member 10.

In the embodiment of my invention illustrated in Fig. 1, the cylindrical housing 27 and the cap 28 is shown as of conducting material or metal and for this reason it is illustrated as contained completely within the supporting housing 14 with only an annular opening 30 in communication with the atmosphere at the bottom of the housing 14.

In the embodiment of my invention illustrated in Fig. 2 of the drawings, the conical member 17 is shown as having a metallic nut 31 which co-operates therewith to clamp the lower end of the flexible conductor 21, and projecting from the nut 31 there is shown a cylindrical enclosing housing 32 of insulating material which is closed at its lower end by a cap 33 also of insulating material or metal. With this construction it will be safe to allow the cylindrical member 32 to project out of the insulating housing 14 as is illustrated in this figure of the drawings. This construction has some advantages over the one previously described in that it permits a freer escape of any gases generated and reduces the hazard of gases which might be exploded getting into the enclosed insulating housing 14.

It is obvious that if the flexible conductor 21 is expelled from the tube 10 upon the blowing of the fuse element 22 and lies or rests upon the cap 33, this part will become live if cap 33 is of metal as shown in Fig. 1. This would become a hazard under certain circuit conditions. To prevent this it is proposed to use, when desirable, a strip of suitable metal such as indicated at 21a as the conducting means between the end of the conductor 21 and the conical member 19. This strip of metal is soldered or suitably fastened to the conductor 21 in such a manner that the joint is weakened from the current required to melt the fuse element 22 when the conductor 21 is expelled from the tube 10. The mechanical pull exerted thereon due to the rapid expulsion action will break this joint and thus the circuit will be cleared of any mechanical contact between 33 and 19 or 31. It will be noted that the hot gases and arc expelled from the tube 10 upon the blowing of the fuse element 22 will materially aid in weakening this joint also.

By referring to Fig. 3 of the drawings, it will be seen that the fuse element 22 is provided with a central or reduced portion 34, which portion determines the current carrying capacity of the fuse. It will also be seen that the upper end of the fusible element 22 is attached to the termi-

nal head 24 by means of a suitable rivet 35. This head 24, however, it will be understood, can be secured to the fuse 22 by any suitable means. It will also be noted that the flexible lead 21 is secured to the lower end of the fuse 22 so that it forms a continuation of the fuse circuit between the lower terminal 17 mounted upon the fuse link holder 10. At the lower end of the flexible lead 21 it will be noted that the individual strands of the conductor are welded or soldered together and flattened out, as at the point 36, so as to provide a good contacting surface between the flexible conductor 21 and the clamping means previously described. This method may be used as a means of making good contact in case it is decided to omit the flat strip of metal indicated at 21a. This conductor 21 can be of any desired length, this length being determined upon the voltage under which the fuse is to operate, or upon the length of the fuse link holder 10 employed. With this arrangement, it will be noted that with the plug 26 secured to the fuse as shown in this figure of the drawings, there will be provided between the plug 26 and the upper end of the fuse housing, a confined space or chamber in which a pressure will be set up in the event that the fusible portion 34 of the fuse 22 is fused, this pressure being created by heat and expanding vapors due to the arc formed therein and, as a result, the plug 26 will, after the fusible portion 34 has fused, be blown out of the link holder 10 in a manner to interrupt the circuit, as is well understood in the art.

In Fig. 4, which is a modified form of my improved fuse, it will be noted that the upper end of the fusible element 22, designated by the numeral 37, is passed through a suitable washer or disc 38 and doubled back upon itself, as at 39, so as to provide an enlarged portion or head which, when the cap 12 is screwed into place, will be clamped and firmly held in good electrical contact. This modification also shows the plug 26 as provided with a cylindrical sleeve 40 which extends upwardly to a point where it meets the disc 38. This sleeve 40 and the plug 26 are each secured to the fusible element 22 by means of a pin 41. In this arrangement, in addition to providing a novel type of connecting means at the upper end of the fuse, it will be noted that there is also provided by reason of the sleeve 40, a protective means which will prevent injury to the fuse link holder 10 due to any explosion which occurs upon a rupture of the fuse. In this embodiment, it will be understood that the lower end of the fusible element 22, the plug 26, and the sleeve 40 will be projected as a unit out of the expulsion tube 10.

By referring to Fig. 5, it will be noted that the bent back portion 39 of the fuse element 22, by reason of the width of the fuse, provides a relatively large flat area, against which the cap 12 can make contact. This figure of the drawings also shows the disc 38 as having a rectangular opening 42 therein through which the flattened upper portion 37 of the fuse 22 can project.

In Fig. 6, which is a further modified form of my invention, it will be noted that the fusible element 22 with its reduced portion 34 is completely enclosed in what may be termed a cartridge which in many respects resembles that of an ordinary shot gun shell. This cartridge comprises an upper contact portion 43 having a flange 44 by means of which the cartridge is clamped between the cylindrical member 11 and the cap 12. The fuse is shown as extending down through the

contact portion 43 and soldered or welded thereto. Secured on the contact portion 43 there is shown a sleeve 45 which in many respects is similar to the sleeve 40. The lower end of the sleeve 45, however, is open and unsecured to the plug 26, so that when the fusible portion 34 ruptures, the plug 26 will be blown out of the cylindrical sleeve 45, as would the wad of a shot gun shell. With this latter modified form of my invention, it will be possible to surround the fusible portion 34 with any suitable arc extinguishing or quenching material such as is commonly used in fuses of this character. It is also conceivable that some explosive mixture might be embodied in this portion of the fuse so as to facilitate a projection of the plug 26 out of the expulsion tube 10 for the purpose of interrupting the circuit in the event of an overload or short circuit on the line.

With the arrangement above described, it will be readily seen that when a fuse blows it may be readily replaced with a relatively short fusible element which, by reason of its construction and size, will be much cheaper than fuses provided in accordance with present day practice and this will be particularly true when it is appreciated that by this construction damage to the fuse housing proper and the terminal supporting housing is prevented.

It might be also stated that with this improved type of fuse link, it would be possible to operate the fuse at a value relatively near its melting point continuously, if necessary, without fear of overheating, charring, or weakening the insulated tubular member 10. This reduction in the heating effect of my improved fuse may be explained by the fact that the flexible conductor 21, being a good conductor of electricity, will not have a tendency to heat up as would an alloy of higher resistance.

It is to be understood that a housing such as that illustrated at 14 on Figs. 1 and 2 may be used when desired in connection with any of the modifications of my invention.

Another advantage of my improved fuse is that the amount of metal to be fused in interrupting the circuit is reduced to a minimum and, as a result, there is a relatively small amount of metal to be melted and, consequently, the arc is interrupted in a more rapid and effective manner.

While I have, for the sake of clearness and in order to disclose my invention so that the same can be readily understood, described and illustrated specific devices and arrangements, I desire to have it understood that this invention is not limited to the specific means disclosed but may be embodied in other ways that will suggest themselves, in view of this broad disclosure, to persons skilled in the art. It is believed that this invention is broadly new and it is desired to claim it as such so that all such changes come within the scope of the appended claims are to be considered as part of this invention.

Having thus described my invention, what I claim and desire to secure by Letters Patent is—

1. In a fuse device of the expulsion type, the combination of a relatively long fuse containing member adapted to be closed at one end and provided with a discharge opening at the opposite end, said fuse containing member having suitable contacts at opposite ends thereof adapted to cooperate with an electric circuit, a low melting point fusible element located in the closed end of said fuse containing member and engaging one of said contacts, a flexible high melting point conductor connected to one end of said fusible ele-

ment and extending through said fuse containing member and connected with the other contact at the opposite end of said fuse containing member, means interposed between the fusible portion of said fuse and said flexible conductor adapted when said fuse ruptures to project said conductor out of said body member to draw out and extinguish any arc formed when the fuse ruptures, and a trap member connected with the discharge end of the containing member and having an enlarged chamber formed therein adapted to prevent the escape of flaming or molten particles from said fuse, said trap member being vented to permit escape of gases entering the same.

2. In a fuse device of the expulsion type the combination with a relatively long insulating tube closed at one end and open at the other, of a fuse element in the tube, said tube having an enlarged chamber at one end thereof in communication with the open end of the tube and in alignment therewith, and means in said enlarged chamber to prevent escape of flaming or molten particles without interfering with the escape of gases when the fuse blows.

3. In a fuse device of the expulsion type the combination with a relatively long insulating tube closed at one end and open at the other, of a fuse element in the tube, said tube having an enlarged chamber at one end thereof in communication with the open end of the tube and in alignment therewith, and a screen cooperating with the enlarged chamber to prevent escape of flaming or molten particles but allowing escape of gases when the fuse blows.

4. In a fuse device of the expulsion type the combination with a relatively long insulating tube closed at one end and open at the other, of a fuse element in the tube, said tube having an enlarged chamber at one end thereof in communication with the open end of the tube and in alignment therewith, a screen cooperating with the enlarged chamber to prevent escape of flaming or molten particles but allowing escape of gases when the fuse blows, and an arc cooling means in the enlarged chamber for rapidly dissipating heat and to assist said screen in preventing the escape of flaming and molten material.

5. In an expulsion fuse having a relatively long tube with terminals at opposite ends with an enlarged chamber at one end of the tube containing means to prevent escape of flaming or molten particles, a fuse link for insertion in said tube, said fuse link consisting of a relatively short low current carrying capacity fusible element on one end, a weakened greater current carrying capacity connector at the other end, a relatively long non-fusible high conductivity conductor connecting said short fusible element and weakened connector, and means for connecting said fuse link to the terminals of the tube.

6. In an expulsion fuse having a relatively long tube with terminals at opposite ends with an enlarged chamber at one end of the tube containing means to prevent escape of flaming or molten particles, a fuse link for insertion in said tube, said fuse link consisting of a relatively short low current carrying capacity fusible element on one end, a weakened greater current carrying capacity connector at the other end, a relatively long non-fusible high conductivity conductor connecting said short fusible element and weakened connector, means for connecting said fuse link to the terminals of the tube, and means

within the tube actuated by pressure produced by said short low current carrying capacity fusible element when it blows for expelling said non-fusible conductor from the tube and to break said weakened connection from its terminal.

7. An electric expulsion fuse device comprising an elongated insulating tube with metallic end terminals, one end of the tube being open and the other end being closed, said open end communicating with an enlarged chamber permitting escape of gases but preventing escape of flaming or molten particles, a short fusible element connected to the terminal adjacent the closed end of the tube, a relatively non-fusible conductor connected to said fusible element and extending longitudinally within the same, a weakened connector connecting the opposite end of the relatively non-fusible conductor to the terminal adjacent the open end of the tube, and means actuated by pressure produced by said short fusible element when it blows to expel said non-fusible conductor from the tube and to break said weakened connector with relation to the terminal adjacent the open end of the tube.

8. In an expulsion fuse device an elongated insulating tube with metallic end terminals adapted to receive a renewable fuse cartridge, said cartridge comprising a tubular shell with a closure at one end, an expellable member for the other end of the cartridge, said expellable member forming a seal, a short fusible element within the shell and connected to the expellable member, means for connecting the fusible element with the end terminals, and an arc extinguishing substance surrounding the fusible element and confined by the expellable member.

9. In a fuse device of the expulsion type, a housing, an expulsion tube of insulating material insertable in said housing, a fuse element within the tube, said tube having an enlarged chamber formed therein and in continuation of the tube, a receptacle in said chamber to receive expelled parts, means in the chamber for cooling hot expelled gases, and means for permitting an escape of the cooled gases through an opening formed in the first-named housing whereby said cooled gases are conducted without the housing.

10. In a high tension fuse device, a member formed of insulating material having a passage formed therein to receive a renewable fuse cartridge, and a receptacle connected with the passage to receive expelled parts from the renewable fuse cartridge.

11. In a high tension fuse device, a tube member formed of insulating material, a terminal member on one end adapted to receive a renewable fuse cartridge, and a receptacle connected with the other end to receive expelled parts from the renewable fuse cartridge.

12. In a high tension fuse device, a tube member formed of insulating material, a terminal member on one end adapted to receive a renewable fuse cartridge, a receptacle connected with the other end to receive expelled parts from the renewable fuse cartridge, and means in the receptacle for rapidly cooling hot gases generated during the blowing of the fuse.

13. An expulsion type fuse comprising a tube open at one end, a fuse element in said tube, a catching device disposed adjacent said open end of the tube and in the path of the metal and gases expelled upon fuse rupture, and a screen through which said expelled gases escape, said screen serving to deionize said expelled gases.

14. An expulsion-type fuse comprising a tube open at one end at all times, a fuse element in said tube, a catching device in the form of a metal cup having a plurality of openings therein, said metal cup being fastened to and wholly supported from one end of the tube and being disposed over said open end of the tube in the path of the metal and gases expelled upon fuse rupture for catching the metal expelled from the tube and for deionizing the expelled gases.

15. In a fuse, a tube of insulating material, a contact mounted on the outside of said tube of insulating material at each end thereof, a fuse link in said tube connected between said contacts, said fuse link including a fusible portion at one end of the tube and a flexible conductor extending to the other end of the tube, said tube being open at the end opposite said fusible portion of the fuse link to permit an expulsion action through the whole length of the tube, and a catching device mounted on the open end of the tube, said catching device having a portion in alignment with the opening of the tube and spaced from the end thereof for stopping the metal expelled from the tube.

16. In a fuse, a tube of insulating material, a contact ferrule around the tube of insulating material adjacent each end thereof, said tube having an opening therethrough for substantially the whole distance between said contact ferrules, a fuse element in said opening through the tube and connected between said contact ferrules, said fuse element having a fusible portion at one end closely adjacent to one of said contact ferrules and having a flexible conducting portion extending to the other of said contact ferrules, and said tube being open at least during the extinguishing of the arc at the end opposite the fusible portion of the fuse element to permit an expulsion action through the tube for substantially the whole length thereof, and a catching device in the form of a metal cup having a plurality of openings therein, said metal cup being supported on one of the contact ferrules and extending beyond the end of the tube for catching metal particles expelled from the tube.

17. In a fuse device, a pair of spaced terminal contact clips, a fuse including an insulating tube having a contact ferrule adjacent each end thereof, said fuse being supported by said terminal contact clips with each of said contact ferrules in engagement with one of said terminal contact clips, a fuse element in said tube connected between said contact ferrules, one end of said tube being open at least during the extinguishing of the arc with an opening at least substantially as large as the opening through the tube to permit an expulsion action out the end of the tube, and a metal chamber supported on the contact ferrule adjacent the open end of the tube and having a portion extending beyond and over the open end of the tube.

18. In a fuse, an insulating tube having contact means adjacent each end thereof, a fuse element in said tube connected between said contact means, one end of said tube being open at least during the extinguishing of heavy-current arcs with an opening at least substantially as large as the opening in the tube around the fuse element to permit an expulsion action out the end of the

tube, a metal chamber supported by the contact means adjacent the open end of the tube and extending over and beyond the open end of the tube, said chamber having metallic means positioned therein providing a large area of surface for cooling and deionizing the gases expelled from the tube.

19. In a fuse, an insulating tube having the opening therein filled with air only, contact means mounted on said tube adjacent each end thereof, a fuse element in said tube connected between said contact means on the tube, one end of said tube being open at least during the extinguishing of heavy-current arcs to permit an expulsion action out the end of the tube, an enlarged chamber supported by the contact means adjacent the open end of the tube and extending over and beyond the open end of the tube, said chamber having metallic means positioned therein providing a large area of surface for cooling and deionizing the gases expelled from the tube.

20. In a fuse device of the expulsion type, the combination with a relatively long insulating tube, closed at one end and open at the other, of a fuse element in the tube, said tube having an enlarged metallic chamber at one end thereof in communication with the open end of the tube, and in alignment therewith, and metallic means in said enlarged chamber to prevent escape of flaming or molten particles, without interfering with the escape of gases, when the fuse blows.

21. In a fuse device of the expulsion type, the combination with a relatively long insulating tube closed at one end and open at the other, of a fuse element in the tube, said tube having an enlarged metal chamber at one end thereof in communication with the open end of the tube and in alignment therewith, and a metal screen cooperating with the enlarged chamber to prevent escape of flaming or molten particles but allowing escape of gases when the fuse blows.

22. In a high tension fuse device, a member formed of insulating material having a passage formed therein to receive a renewable fuse cartridge, and a metallic receptacle connected with the passage to receive expelled parts from the renewable fuse cartridge.

23. In a high tension fuse device, a tube member formed of insulating material, a terminal member on one end adapted to receive a renewable fuse cartridge, and a metallic receptacle connected with the other end to receive expelled parts from the renewable fuse cartridge.

24. In a high tension fuse device, a tube member formed of insulating material, a terminal member on one end adapted to receive a renewable fuse cartridge, a metallic receptacle connected with the other end to receive expelled parts from the renewable fuse cartridge, and metallic means in the receptacle for rapidly cooling hot gases generated during the blowing of the fuse.

25. An expulsion type fuse comprising a tube open at one end, a fuse element in said tube, a metallic catching device disposed adjacent said open end of the tube and in the path of the metal and gases expelled upon fuse rupture, and a metallic screen through which said expelled gases escape, said screen serving to deionize said expelled gases.

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